CLAIMS

1. A downhole tool comprising:

a body defining a bore and comprising a valve arrangement including at least one flow port in the wall of the body and whereby the port may be selectively opened and closed; and

a variable flow restriction in the bore, the degree of restriction tending to decrease as flow across the restriction increases.

2. The tool of claim 1, wherein the variable flow restriction is adapted to control fluid flow through the body bore below the ports.

3. The tool of claim 2, wherein the variable flow restriction is adapted to selectively close the bore below the flow port.

4. The tool of any of the preceding claims, wherein the body is adapted to be incorporated in a string of tubing.

5. The tool of any of the preceding claims, wherein the variable flow restriction is adapted to create a pressure differential and the resulting force utilised to actuate the valve arrangement.

6. The tool of any of the preceding claims, wherein the valve arrangement is biased towards an open configuration.

7. The tool of any of claims 1 to 5, wherein valve arrangement is biased towards a closed configuration.

8. The tool of any of the preceding claims, wherein the valve arrangement is initially retained in one of an open configuration and a closed configuration.

9. The tool of claim 8, wherein after release from the initial configuration the valve arrangement tends to move to the other configuration.

10. The tool of any of the preceding claims, wherein the valve arrangement includes control means for at least one of controlling the sequence of operation of the valve arrangement and controlling the response of the valve arrangement to actuation forces.

11. The tool of claim 10, wherein the control means comprises a cam arrangement between a movable valve element and the body.

12. The tool of claim 10 or 11, wherein the control means comprises a cam arrangement between a valve actuator and a valve element.

13. The tool of any of the preceding claims, wherein the valve arrangement is flow-actuated.

14. The tool of claim 13, wherein the valve arrangement is adapted to be actuated by a differential fluid pressure acting across at least one flow restriction in the bore.

15. The tool of claim 14, wherein said flow restriction is provided, at least in part, by the variable flow restriction.

16. The tool of claim 14 or 15, wherein said flow restriction is provided, at least in part, by a further flow restriction.

17. The tool of claim 14, wherein said flow restriction is provided by a combination of the variable flow restriction and a further flow restriction.

18. The tool of claim 16 or 17, wherein the further flow restriction is a fixed restriction.

19. The tool of claim 16 or 17, wherein the further flow restriction is a variable restriction.

20. The tool of any of claims 16 to 19, wherein the further flow restriction is integral with the tool body.

21. The tool of any of claims 16 to 19, wherein the further flow restriction is provided as a separate unit adapted to be selectively located in the body.

22. The tool of any of claims 16 to 21, wherein the further flow restriction is provided above said variable flow restriction.

23. The tool of any of the preceding claims, wherein the variable flow restriction features a tight configuration in which the restriction substantially closes the body bore.

24. The tool of claims 23, wherein in the tight configuration the variable flow restriction is configured to permit pressure equalisation thereacross.

25. The tool of any of claims 1 to 22, wherein the variable flow restriction features a tight configuration in which the flow restriction allows flow through the bore.

26. The tool of any of the preceding claims, wherein the variable flow restriction is positioned upstream of the flow port.

27. The tool of any of claims 1 to 25, wherein the variable flow restriction is positioned downstream of the flow port.

28. The tool of any of the preceding claims, wherein the variable flow restriction is integral with the body.

29. The tool of any of claims 1 to 27, wherein the variable flow restriction is provided as a separate unit adapted to be selectively located in the body.

30. A method of controlling flow between a tubular downhole string and a surrounding annulus, the method comprising:

providing a valve arrangement in a tubular downhole string, the valve arrangement having a flow port providing fluid communication between the string bore and the surrounding annulus and a variable flow restriction;

pumping fluid through the string;

selectively opening and closing the flow port; and

increasing the flow rate through the flow restriction to decrease the degree of restriction provided by the flow restriction.

31. The method of claim 30, comprising varying the configuration of the variable flow restriction to control fluid flow through the body bore below the ports.

32. The method of claim 30 or 31, comprising utilising the variable flow restriction to close the bore below the flow port, such that all of the fluid is directed through the flow port.

33. The method of any of claims 30 to 32, comprising utilising the variable flow restriction to permit a proportion of the fluid to pass through the bore while a proportion of the fluid is redirected through the flow port.

34. The method of any of claims 30 to 33, comprising utilising the variable flow restriction to create a pressure differential and utilising the resulting force to actuate the valve arrangement.

35. The method of any of claims 30 to 34, comprising biasing the valve arrangement such that the port is normally open.

36. The method of any of claims 30 to 34, comprising biasing the valve arrangement such that the port is normally closed.

37. The method of any of claims 30 to 36, comprising initially retaining the valve arrangement in one of an open configuration and a closed configuration.

38. The method of claim 37, comprising releasing the valve arrangement from the initial retained configuration.

39. The method of claim 38, wherein, following release from the initial retained position, the valve arrangement is moved to the other configuration.

40. The method of any of claims 30 to 39, comprising controlling the sequence of operation of the valve arrangement.

41. The method of any of claims 30 to 40, comprising controlling the response of the valve arrangement to actuation forces.

42. The method of any of claims 30 to 41, comprising actuating the valve arrangement by a differential fluid pressure acting across at least one flow restriction in the bore.

43. The method of claim 42, wherein the differential fluid pressure acts across the variable flow restriction.

44. The method of claim 42, wherein the differential fluid pressure acts across a further flow restriction.

45. The method of claim 42, wherein the differential fluid pressure acts across the variable flow restriction and a further flow restriction.

46. The method of claim 44 or 45, comprising providing the further flow restriction as a separate unit and dropping the further flow restriction into the body.

47. The method of any of claims 30 to 46, comprising configuring the variable flow restriction to close the body bore.

48. The method of any of claims 30 to 46, comprising configuring the variable flow restriction in a minimum flow configuration permitting flow through the bore.

49. The method of any of claims 30 to 48, comprising positioning the variable flow restriction upstream of the flow port.

50. The method of claim 49, comprising utilising the variable flow restriction to prevent flow of fluid through both the bore and the flow port.

51. The method of any of claims 30 to 48, comprising utilising the variable flow restriction to direct all of the fluid flowing into the tool through the flow port.

52. The method of any of the preceding claims, comprising providing the variable flow restriction as a separate unit and dropping the unit into the body.

53. A fluid-actuated tool comprising:

a body comprising a valve arrangement including at least one flow port in a wall of the body and whereby the port may be selectively opened and closed; and

a flow restriction operatively associated with the valve arrangement and upstream of the at least one flow port whereby fluid flow through the restriction creates a valve-actuating force and whereby the flow restriction has a variable, flow-related configuration.

54. The tool of claim 53, wherein the tool is a downhole tool.

55. The tool of claim 54, wherein the tool is a bypass tool.

56. The tool of any of claims 53 to 55, wherein the valve arrangement is adapted to be selectively isolated from the flow restriction such that flow through the restriction does not impact on the valve configuration.

57. The tool of any of claims 53 to 56, including an arrangement adapted to releasably retain the valve arrangement in an initial configuration.

58. The tool of claim 57, wherein said arrangement is at least one of a shear pin and a sprung pin.

59. The tool of any of claims 53 to 58, comprising an arrangement for controlling the interaction between the restriction and the valve arrangement.

60. The tool of claim 59, wherein said arrangement is configured to be cycled between different configurations.

61. The tool of any of claims 53 to 60, wherein the flow restriction comprises at least one of a nozzle and a choke.

62. The tool of any of claims 53 to 61, wherein the configuration of the restriction is variable by changing the flow area defined by the restriction in response to flow-related forces experienced by the restriction.

63. The tool of any of claims 53 to 62, wherein the restriction normally defines a smaller flow area.

64. The tool of claim 63, wherein the smaller flow area is such to substantially prevent flow through the restriction.

65. The tool of claims 63 or 64, wherein the restriction is spring biased towards the smaller flow area configuration.

66. The tool of any of claims 53 to 65, wherein the restriction is adapted to reconfigure to define a larger flow area on experiencing a pressure differential force above a predetermined level.

67. The tool of claim 66, wherein part of the restriction is spring-mounted, such that the part moves when the differential pressure force acting on the part overcomes the spring force.

68. The tool of claim 67, wherein movement of the part is damped.

69. The tool of any of claims 53 to 68, wherein the flow restriction comprises at least two relatively movable parts, the parts being movable to vary the degree of restriction.

70. The tool of claim 69, wherein the restriction comprises an orifice and a spear, the orifice being axially movable relative to the spear to vary the area of the annulus between the spear and the orifice.

71. The tool of any of claims 53 to 70, wherein the flow restriction is integral with the tool body.

72. The tool of any of claims 53 to 70, wherein the flow restriction is provided as a separate unit adapted to be located in the tool body.

73. The tool of claim 72, wherein the flow restriction is adapted to be pumped from surface through the string to land on and engage with the body.

74. The tool of any of claims 53 to 73, wherein the restriction comprises a sleeve.

75. The tool of any of claims 53 to 74, wherein the restriction comprises a variable orifice.

76. The tool of any of claims 53 to 75, wherein the restriction is adapted to be retrievable.

77. The tool of any of claims 53 to 76, wherein the valve arrangement comprises a sleeve.

78. The tool of claim 77, wherein the sleeve is at least one of axially and rotatably movable relative to a body wall portion.

79. The tool of claim 77 or 78, wherein at least one of the sleeve and the body wall define the one or more flow ports.

80. The tool of claim 79, wherein the sleeve is biased to close the ports.

81. The tool of claim 79, wherein the sleeve is biased to open the ports.

82. The tool of any of claims 77 to 81, wherein the sleeve is mounted internally of the body.

83. A method of controlling fluid flow in a downhole tubular string comprising:

Providing a valve arrangement in a string, the valve arrangement including a flow port providing fluid communication between the strings bore and the surrounding annulus;

providing a flow restriction in the string upstream of the flow port;

flowing fluid flow through the restriction to actuate the valve arrangement; and

varying the configuration of the restriction.

84. A tool comprising a body including a fluid actuated device including a flow restriction whereby fluid flow through the restriction creates an actuating force and whereby the flow restriction has a variable, flow-related configuration.